Iowa Science Teachers Journal

Volume 15 | Number 1 Article 8

1978

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Introduction

We are living in a world which, depending on personal attitude, may to some degree be materialistic in its value orientation, but most certainly is materials-oriented. (Materials are defined here as substances that become useful to society after some form of processing, *e.g.*, mining, harvesting, refining, or fabrication. This excludes foods, drugs, water, and fossil fuels). There are strong indications that the rate and degree of change in the use of materials by our children -and theirs- will reach a point beyond what we can presently envision. In fact, the current emphasis on precarious supplies of fossil fuels has tended to obscure similar trends in certain materials resources. The real problem then is how to get from here to there with a minimum of societal tension but without having a clear picture of where and what *there* is.

If you but begin to scratch the surface of the vast amount of literature regarding materials resources and use published in the last quarter century by Presidential commissions, national committees, public and private agencies, and special task forces, you will be awe-struck at the unmistakable indicators pointing toward an unfamiliar world. One example may suffice. In 1972, an ad hoc committee report *Elements of a National Materials Policy*, issued by the National Materials Advisory Board of the National Research Council, stated, "The American life style, insofar as it depends upon materials, is changing and will continue to change in the near future as the nation pays the deferred social costs of past consumption and inequities in distribution and begins to calculate the costs of depletion, replacement of non-renewable resources, and environmental restoration and protection." However, one particular disturbing aspect of many such reports is their proclivity to deal with the need to develop new technologies and to anticipate – if not recommend – increased government intervention in all phases of the materials cycle to assure that the emerging technologies are successful. This emphasis on the role of technology and government ignores the unavoidable and fundamental interface with man. In only a few recent reports has some mention been made of the desirability to educate students in certain aspects of the materials cycle. The working of some recommendations implies a "crash course" approach designed with the expectation of immediate compliance and success on a national level.

It is my contention that education at all age levels is the immediate requisite and continuing underpinning which must accompany all of us on our journey from here to there with minimum disruption in the societal well-being of the community of man. In this article I would like to briefly review how we got where we are and to suggest what some of the specific materials issues are as they impinge on educable man.

How We Got Here

The U.S. industrial history may be thought of as comprising periods highlighting extraction, manufacturing and, since about 1960, services. After the transition from agrarian to factory industries, the notion of limitless natural resources met its first warning signal during World War I when shortages of some military supplies were encountered. Continuing exploration for and new discoveries of natural resources quickly rekindled the concept of infinite resources and nourished the rural to urban migration. World War II was again accompanied by its own set of shortages. Statistics gathered in the years following the war showed an alarming rate of materials use and increased dependence on foreign sources.

In the years 1946 to 1973 more than one dozen different attempts were made at the Federal level to assess materials use with an eye toward the future of the national economy. Issues have included stockpiling of materials thought to be critical, initiation of domestic policies providing assistance for expanded exploration and mining, development of foreign policies and international arrangements by which investments in developing countries could be made secure and the U.S. assured of continued access to foreign raw materials, and finally consideration of the complex subject of environmental quality with its ties to management of materials and ecosystems. It would appear that a national materials policy is needed now more than ever to ensure continuing domestic industrial and economic stability and to provide an orderly structure for the legitimate claims of developing countries to a slice of the world's materials pie. The many previous attempts in this direction have been narrow and spasmodic. It is perhaps precisely because of such poorly-conceived, insular, and partially-executed ventures that contemporary efforts recognize the full scope and complexities involved. National and global materials decisions touch on every aspect of human life and demand an unaccustomed degree of flexibility.

The fact remains that despite our materials blessings the U.S. has since 1920 become a net importer. Indeed, we presently import more than half of our needs for some 20 nonfuel minerals, among which are critical key metals. It is also a fact that a "depletion history" can be graphed for certain materials; and it appears reasonable to expect that such histories will extend to an increasingly wider range of seemingly necessary materials. Such depletion histories have been applied to naturally-concentrated materials bodies. Even with the injection of new technologies to mine lower-grade materials initially bypassed, depletion histories show the familiar and unvaried life cycle stages of youth, maturity, and finally exhaustion.

Man's association with materials can be summed up simply in one word: dispersion. The automobile, for example, is not only a conglomeration of various metals, plastics, glass, and rubber; but also a vehicle which aids in further distribution of once-concentrated materials.

Where Are We?

A paper conflict is being waged between "catastrophists" and "cornucopians". The former argue that the soon-to-be-encountered resource exhaustion will lead to society's collapse; the latter maintain that since nonfuel materials cannot be destroyed, the supply is infinite and society will increasingly turn toward lower-grade materials. This conflict has recently been joined by the "substitutionists" who foresee an Age of Substitutability when society will have found an inexhaustible, nonpolluting source of energy with which to maintain a standard of living approximately comparable to that of today. The Substitutionists believe both in an inexhaustible or nearly inexhaustible supply of minerals, albeit of low quality, and in the ability of society to adapt its needs by substituting one material or element for another.

The historical materials cycle (supply, use, disposal) is open-ended and underscores man's role as a dispersing agent. One recommendation, viewed in the context of dwindling concentrated mineral resources, is that the less that is used, the longer it will last. This would not only prolong the agony but is also economically unrealistic. Another approach is to reuse or to recover materials after disposal. The materials cycle may then be considered as partially closed, *i.e.* with several feedback loops.

Materials recycling is by no means a twentieth-century innovation, but recent economic events are leading to a growing public conviction of its merit and necessity. The overriding driving forces *at present* are the rising costs and problems of waste disposal. Landfilling of garbage has come under increasing criticism because of a growing shortage of suitable sites and a concern that such sites may not be as sanitary as desired in the long term. Future potentials accruing from resource recovery, especially from municipal solid wastes, include a possible alleviation of some materials shortages and the realization of energy savings as recycled materials take the place of raw ore in industrial processes. However, the total picture of resource recovery envisioned for the year 2000 is vastly more complex than most realize.

From Here to There

Certainly more is involved than stacking newspapers in the garage or returning bottles to the grocery store for a deposit refund. Although based on current knowledge of materials use and disposal, the projected scenario must also take into consideration all aspects of the anticipated, modified materials cycle and the interactive constraints in the non-fuel materials – energy – environment system. What are some of the implications for present-day and future man?

Among the adjectives describing our society must be the words "containerized" or "packaged". Bottles, cans, cartons, and plastic packaging constitute a considerable portion of municipal waste. The production of standardized bottles will permit not only return but also reuse. Packaging, which often has advertising as a primary function, will perform its originally intended use of protecting a high quality product. Automobiles, appliances, and other long-life, durable items will indeed be that. Product design, possibly standardized in some areas, will be geared for longevity and ease of repair. Without affecting the intended quality or performance of an item, its design will be such as to facilitate recovery with particular emphasis on scarcest materials. Separation of certain materials prior to disposal by the consumer will reduce the energy necessary to separate them once dumped from a garbage truck.

The intent of these and other plans is to reverse man's role as disperser or, as some would have it, to reduce the entropy of the materials system. It is anticipated that the volume and composition of the waste stream will change, thereby requiring a considerable degree of flexibility in the initial design and continued operation of resource recovery plants located regionally throughout the U.S. The costs to industry, dramatic shifts in employment, and a re-definition of what is known as our standard of living are expected.

That all of this and more will occur, perhaps with some modifications, appears virtually certain. At what rate and to what extent depends on man's adaptability to inevitable change.

Adaptive Man

As recent experience shows, it is not difficult to initiate interest among certain groups of individuals, *e.g.* a fourth-grade class or a Boy Scout troop, to collect newspapers, or aluminum cans, or glass bottles for recovery purposes. These exercises are successful in that they involve some degree of personal, physical, and intellectual awareness and commitment. Such salvage efforts are often a one-shot affair which for various reasons are terminated after a time. Waste generation, however, is a continuing process. The above is illustrative of this nation's past approach to materials management: crisis-oriented, our attention span is astoundingly short.

There are also very real signs, especially among the young, that materials (mis)management impinges on human values and morality in a world now including third and fourth world countries. To what extent this notion will be translated into action depends in large measure on the imitable examples of behavior displayed by the adult "real" world of industry, by the educational limitations of increasingly specialized disciplines, and the distrustful provincialism of some professional groups.

These comments on this nation's youth suggest an innate ability and enthusiasm to become involved in the shaping of the world in which they live. This is contrary to the often-held concept that only as adults will youth inherit the world. Although it is true that adults are frequently involved in programs focused at social change, other adults not directly involved in such programs find the suggested changes difficult. Social change programs, whose ultimate target is the child and young adult, can utilize the natural flexibility of this age group by encouraging the expectation of change and by suggesting that personal desires, goals, and decisions are directly related to the kind and magnitude of such changes. Education of young people is a necessary way to sensitize the general population to current and developing materials shortages and their inevitable effect of our life style. Therefore, what is needed is a mechanism by which materials-oriented problems and possible solutions can be understood and anticipated.

Materials 2000 Seminar

To this end the Department of Materials Science and Engineering in cooperation with the Extension Service at Iowa State University has submitted proposals to various Federal agencies requesting funds to assist in the implementation of a three-day seminar-workshop August 14-16, 1978, entitled MATERIALS 2000 SEMINAR. Invitations to participate will be extended to K-12 teachers in the State of Iowa, although actual participation will be limited to approximately 100 individuals. Applicants will be selected so as to ensure a heterogeneous K-12 mix, although perference will be given to clusters of teachers from single schools or communities.

The theme of the seminar is the total materials flow and its relationship to anticipated changes affecting life styles. Presentations by an interdisciplinary team of selected Iowa State University faculty will include:

– historical perspective of materials, culture, and technology.

– materials availability, domestic and international

– economic development in exporting countries

– forest products and wood chemistry

– impact of automated processing on cost and labor force

– role of advertising

– municipal wastes and technologies for resource recovery

– enacted and needed national legislation

– wants + energy + materials = goods + residuals + bads

– legitimizing frugality

– present and future availability and consumer behavior

Hand-out printed material will supplement the presentation. Workshop sessions will focus on teaching strategies which can be employed in transferring selected concepts to students.

It is not intended that the subject matter of this seminar replace existing curricula; rather the general theme of materials and its relationship to the future of man should be woven into existing K-12 subject matter courses. To emphasize and support the teachers' ongoing efforts in this regard, two one-day sessions will be held at six and nine month intervals after the seminar at selected sites around the state. At these sessions the teachers themselves will be expected to report on novel, innovative, and hopefully creative techniques or other means through which they were able to communicate some of the seminar's concepts to their students.

It is planned that at least a part of the participants' expenses will be reimbursed and that Continuing Education Units or University credit may be earned upon successful completion of the project. Such matters are necessarily contingent upon receiving the necessary funds from the funding agency. It is also planned that such seminars be held on an annual basis to provide for optimum long-term educational benefits, maximum statewide teacher participation, and continual updating of practical information.

Expressions of interest and requests for further information as it become available may be addressed to:

MATERIALS 2000 SEMINAR
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and Engineering
110 Engineering Annex
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Environmental Simulations

Five computer simulation units dealing with increasingly important environmental issues are now available as guides for students and teachers. Published by the Northwest Regional Educational Laboratory, these teaching materials are written for BASIC language computer utilization and are appropriate for use by students in grades 9-14 in such subject areas as social studies, science, mathematics, environmental education and computer sciences.

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Honors to Iowans

Several Iowans are listed in the 37th Annual Science Talent Search for the Westinghouse Science Scholarships and Awards for 1978. This program is administered by the Science Clubs of America. All students awarded Honors in the Science Talent Search are considered so outstanding that any institution of higher learning is justified in considering their abilities carefully when making admissions and awarding scholarships. The Iowans listed are:

James Paul Mitchell of Aburnett, for studies on a light emitting diode television screen.

Harry Georson Coin of Bettendorf, for studies on the construction and uses of a television display for telephone computer terminals.

Bruce Brocka of Davenport for studies on 1612 MHz emission in *symbiotic systems* .

Linda Mary Bernes of Dubuque, for studies on the elevation of the earth's temperature due to CO_2 pollution and positive feedback cycles.

Lance Gordon Johnson of Spirit Lake, for studies on the fracture mechanics of a monofilament whip operated in a rotary cutting mode.

ISTJ wishes to congratulate all the students and their teachers for such outstanding work.